

## Fabrication, Testing, and Analysis of a Flow Boiling Test Facility With Enhanced Surface Characterization Capability

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The evolution of aerospace applications (spacecraft, satellites, platforms, probes, etc.) will place increasing demands on thermal control systems (TCS). These systems will require more efficient designs with higher heat rejection capabilities. An obvious solution to these challenges is the development of sophisticated two-phase flow systems that provide high heat transfer and reduced flow rates through the use of latent heat of vaporization.

Optimization of two-phase systems requires careful investigation of state-of-the-art heat transfer technology. This effort focuses on combining environmentally safe (non-CFC) refrigerants with enhanced surface technology. It will culminate in a data base of properties (corresponding to operating conditions unique to typical aerospace applications) for use in advanced TCS design.

This Center Director's Discretionary Fund (CDDF) will result in the development of a flow boiling facility (fig. 66) that will be made up primarily of components from previously completed small business contracts (SBIR's) and an experimental CDDF apparatus that is being used to investigate jet pump-based heat rejection. Typical test data are based on specific

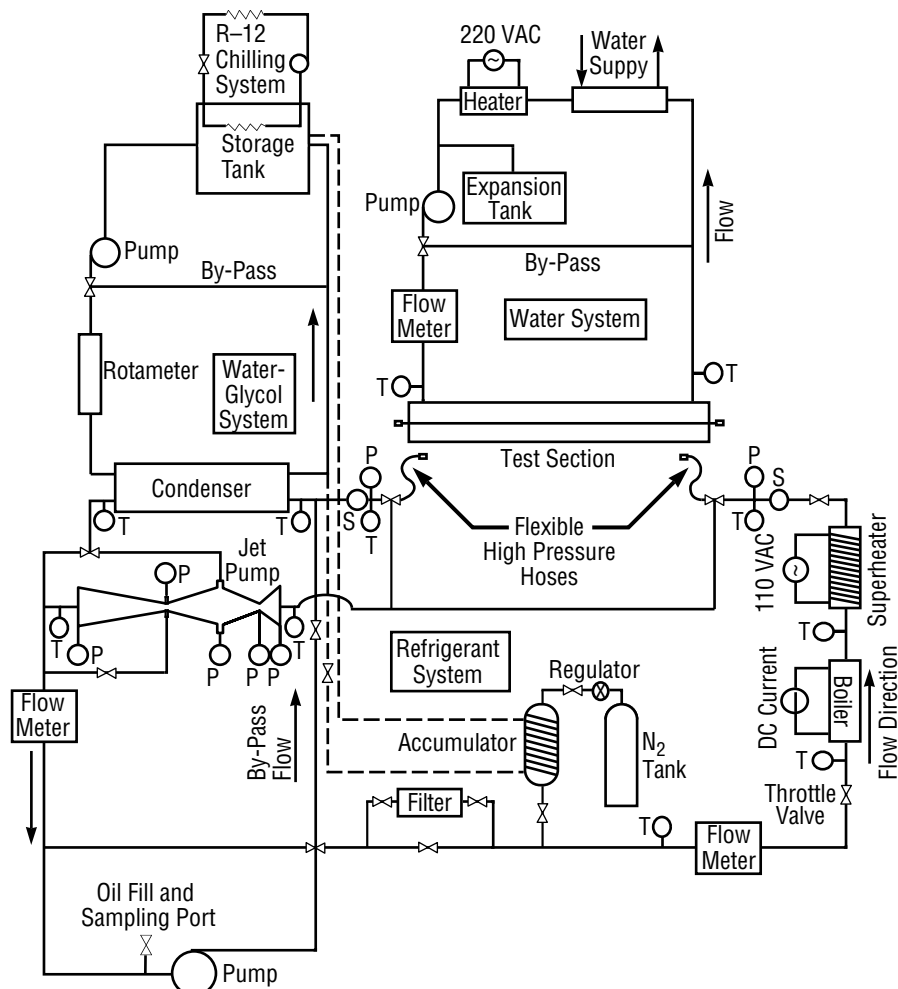


FIGURE 66.—Schematic for flow boiling apparatus using water heated/cooled test section.

commercial applications (i.e., home and automobile air-conditioning systems, refrigeration units, etc.). Specialized aerospace applications will require information outside this range of data. A flow boiling test apparatus will not only provide data necessary to design highly efficient two-phase TCS's but can also be used to evaluate alternative (non-CFC) refrigerants and their performance using various heat exchangers with state-of-the-art heat transfer augmentation (enhanced surfaces).

Initially a survey of previously developed flow facilities was completed. An investigation into fluid property data bases was conducted. Investigation of several referenced fluid property computational methods (curve fits) yielded inadequate results leading to the decision to build a fluid property FORTRAN program in-house. The program, which has already been completed and verified, provides n-spline interpolation of ASHRAE data.

Two approaches were developed to provide fluid hydraulic analysis capability of the test

loop(s): A systems improved numerical differencing analyzer (SINDA) '85 Fluint model, and a C (programming language) code which will allow timely evaluations of changes in test loop design parameters. In addition to the analytical work, a test area was set up and a chiller from a previous SBIR program was moved to the area with checkout and installation pending. A survey of existing hardware along with assessment of vendor hardware to be incorporated into the facility has been completed.

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**University Involvement:** Douglas Nelson, University of Virginia

**Biographical Sketch:** Jon Holladay, Patrick Hunt, and Melissa Gard are members of MSFC's Thermal and Life Support Division team. They have over 30 years of experience in the thermal fluids area. Jon Holladay has bachelor and master of science degrees in mechanical engineering from the University of Alabama. Hunt earned bachelor and master degrees in mechanical engineering from Auburn University, and Gard has a bachelor of science degree in engineering physics from Southwestern Oklahoma State University.

